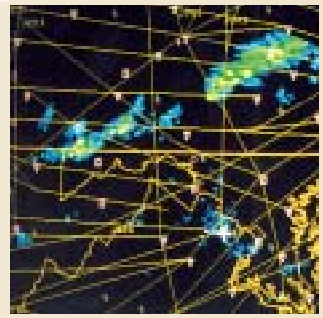
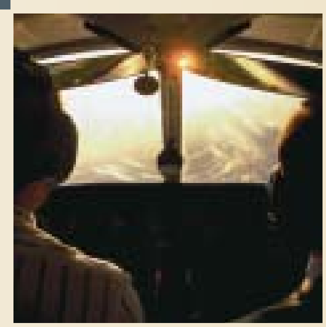
Weather Tactics





Weather, ATC, and You

Washington Air Route Traffic Control Center

Foreword

The following pages will take you on "Operation Rain Check" tours of Washington Dulles International Airport (KIAD), the Washington Air Route Traffic Control Center (ZDC), and the Leesburg (Virginia) Flight Service Station. These facilities provide information that can help you make decisions critical to your success in avoiding hazardous weather. We'll focus on *weather flying tactics*—ways to utilize the weather resources available through air traffic control (ATC) and flight service while flying through areas of actual or forecast adverse weather. You'll learn how to get information on convective activity, as well as other atmospheric hazards such as icing, turbulence, or encountering IFR conditions during a VFR flight. Dealing with enroute weather involves tactical planning and response. *Because conditions change rapidly, pilots must be prepared for quick decision making and immediate action. In these situations, ATC can provide invaluable assistance*. To make optimal use of ATC's assistance, pilots must be aware of the abilities and limitations of both air traffic controllers and their equipment.

Dealing with Enroute Weather—Tactics

IFR or VFR?

Once the "go" decision has been made, it's time to consider the tactics you'll use to complete the flight in safety and reasonable comfort. If the route takes you through areas of possible adverse weather, the first major issue is whether to go IFR or VFR.

If you're a VFR pilot, the decision is already made. You must remain VFR. Air route traffic control centers (ARTCCs) will probably not have much information on enroute ceiling and visibilities, but terminal approach controllers can often provide useful information on conditions near the airport. Flight service and automated weather equipment can provide information for selected points.

If the route takes you through areas of possible adverse weather, the first major issue is whether to go IFR or VFR.

Operation Raincheck

The FAA encourages pilots to visit air traffic control facilities — towers, Tracons, centers and flight service stations. The agency has established a program, "Operation Raincheck," to facilitate tours of these facilities. The program is predicated on the belief that the more pilots know about the controllers and their equipment, the safer they will be when flying in weather. All pilots—IFR and VFR—are encouraged to take advantage of this program. Call a nearby ATC facility to inquire about Operation Raincheck tour schedules.

View from the tower

If you're instrument rated, you have a choice, and the conservative approach might suggest flying IFR; after all, continued flight from VFR into IFR conditions remains one of the most often cited accident factors in general aviation. But flying VFR could be more prudent in some cases. For example, if afternoon thunderstorms are a possibility, going VFR, and maintaining visual separation from buildups, can be a better option than being stuck in the clouds on an IFR flight plan. Enroute altitude is another important consideration; 2,000 vertical feet can make all the difference between being in the clouds and being above them. The part of the country over which you'll be flying makes a difference, too. Kansas thunderstorms are often easy to spot and avoid; not so with embedded TRW along the East Coast.

Maintaining Flexibility — and Safety

Pilots often look at weather as either IFR or VFR. Standard protocol tells us to inform the briefer whether we are going IFR or VFR—before receiving any weather information. This can be a cart-before-the-horse kind of question, because the decision to file IFR is often based on the forecast. Also, despite advances in meteorology and technology, conditions along a particular route may be markedly different from the forecast. Being flexible means dealing with what is actually happening and not fixating on what was supposed to happen.

A highly visible thunderstorm

The controlling ARTCC facility

Another way to be flexible is to realize there are many gradations of IFR conditions. Pilots talk of "hard IFR" and "solid IFR," signifying conditions of continual low visibility, possibly with ceilings low enough to require instrument approaches down to minimums.

IFR conditions along a route may be only sporadic or only affect a narrow range of altitudes. IFR flights may be conducted in clear skies or in weather that only occasionally puts the aircraft in instrument meteorological conditions (IMC). VFR conditions also come in many shades, from ceiling and visibility unlimited (CAVU) to deteriorating visibility or low ceilings in which VFR flight, although legal, may not be safe. As stated above, actual and forecast conditions can differ markedly. In some cases, an IFR flight plan may not be needed; in others, one may have to be filed at the last minute.


The eyes are the best means to avoid the weather.

Filing in the Air

Sometimes the need for IFR flight only becomes apparent when airborne. In these cases, there are several ways of getting "into the system."

• If you know or strongly suspect you'll need to go IFR at some point in your flight, you can file a composite flight plan in which you designate the point where you wish to switch from VFR to IFR. At that point, you can contact flight service or, in some cases, ATC, to pick up your IFR clearance. Getting the clearance from ATC will be easier if you're already on flight following.

• It's possible to request an IFR clearance from ATC without having a previously filed IFR flight plan. Controllers will often accommodate such requests if they're not too busy. Pilots must realize, however, that ATC's main responsibility is separating traffic—everything else is secondary.

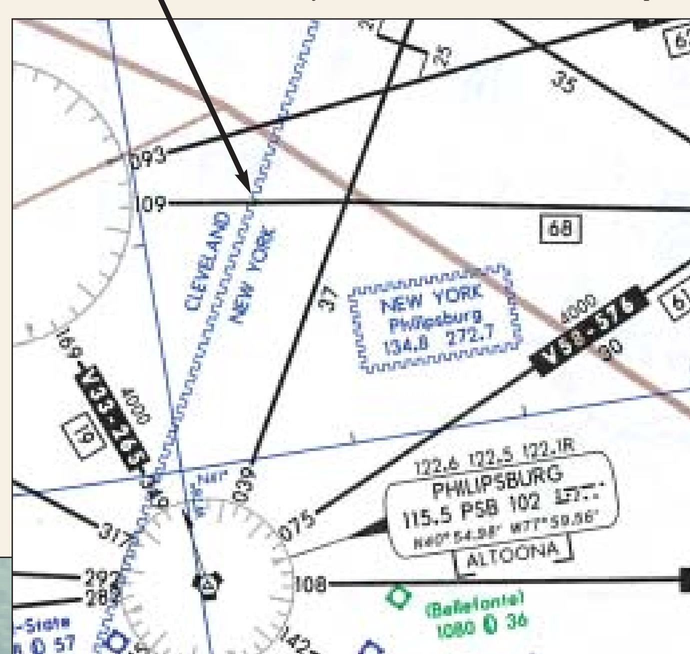
• A surefire way to file in the air is to contact flight service. File an IFR flight plan to be activated over a designated point. Obviously, you can't wait until you're in IMC to ask for a clearance—that requires exercising the least attractive option.

• Declaring an emergency is another way to get IFR service in flight. Both VFR and IFR pilots should never hesitate to use their PIC authority to cope with emergency situations. It's difficult to understand how a prudent aviator could inadvertently stray very far from VMC into IMC, but it happens all too frequently with fatal results.

The Eyes Have It

Pilots' vision has always been the best system for hazardous weather avoidance. If you can see the

The boundary between ARTCC facilities' airspace



clouds, you can avoid them, so pilots should plan all flights to give the best opportunity of seeing the weather. That naturally means adjusting cruising altitude as required, but it may also mean delaying departure or leaving earlier.

Here are some tactics to improve the view:

• Try to get on top of the weather.

• Obviously you won't be able to top thunderstorms, but it's often possible to top the veiling clouds that obscure your view of the nasty stuff.

• IFR pilots should request VFR-on-top clearances. They accord considerable latitude in weather avoidance.

WABASH MUNI, IN (IWH) **Grissom App/Dep Con**—121.05 379.3 **Chicago Center App/Dep Con**—121.05 379.3
WADSWORTH MUNI, OH (3G3) **Akron-Canton App/Dep Con**—118.6 226.4 **Cleveland Center App/Dep Con**—134.9 317.7
WARSAW MUNI, IN (ASW) **AWOS-3** 121.125 **Fort Wayne App/Dep Con**—127.2 284.6 **Clnc Del**—134.05
WASHINGTON CO, PA (AFJ) **AWOS-3** 118.425 **Pittsburgh App/Dep Con**—119.35 388.0 **Clnc Del**—127.3
WASHINGTON CO REGIONAL, MD (HGR) **AWOS-3** 126.375 **Washington Center App/Dep Con**—134.15 385.4 **Hagerstown Twr**—120.3 265.7 **Gnd Con**—121.9 **CLASS D—(Apr-Sep 1200-0300Z‡, Oct-Mar 1200-0100Z‡)**
WASHINGTON DULLES INTL, DC (IAD) **ATIS** 134.85 **App Con**—126.1 384.9 (331°-090°) 124.65 390.9 (091°-240°) 120.45 390.9 (241°-330°) **Dep Con**—126.65 350.2 (121°-299°) 125.05 350.2 (300°-120°) **Twr**—120.1 388.0 **Gnd Con**—121.9 348.6 **Clnc Del**—127.35 348.6 **Midfld Ramp Con**—129.55 **CLASS B—(Continuous)**
WASHINGTON NATIONAL, DC (DCA) **ATIS** 132.65 **App Con**—118.3 306.3 (East) 124.7 338.2 (West) **Twr**—119.1 257.6 120.75 (Helicopters) **Gnd Con**—121.7 257 **Clnc Del**—128.25 **Dep Con**—125.65 396.1 (East 9500' and be 126.55 269.5 (East 10,000' up to FL190) 121.05 343.7 (West 10,(

IFR enroute chart tabular communication data

• ATC is less likely to approve VFR-on-top in crowded airspace. Here pilots should request cruising altitudes that will allow them to see what's ahead at least part of the time.

• VFR-on-top is legal for VFR pilots too, but you've obviously traded one problem for a bigger one if you have to declare an emergency to descend through the clouds.

During IFR flights in actual instrument conditions, our ability to monitor weather visually is significantly restricted. We can't see weather beyond the horizon that may be affecting our destination or peer through a solid cloud deck to know if there is ice, turbulence, or heavy rain ahead. During trying times like these, ATC may be able to provide some answers.

CLASS B, CLASS C, TRSA AND SELECTED RADAR APPROACH CONTROL FREQUENCIES

FACILITY	FREQUENCIES		SERVICE AVAILABILITY
PHILADELPHIA CLASS B		128.4 273.575 (NORTH/NORTHEAST 6500-7500)	CONTINUOUS
		124.35 319.15 (NORTHEAST RWY 09 ACTIVE 10,000 & BELOW)	
		128.4 273.575 (NORTHEAST RWY 27 ACTIVE 5500 & ABOVE)	
		123.8 291.7 (NORTHEAST RWY 27 ACTIVE 5000 & BELOW)	
		119.75 269.25 (SOUTHEAST RWY 09 ACTIVE 10,000 & BELOW)	
		119.75 269.25 (SOUTHEAST RWY 27 ACTIVE 8500-10,000)	
		128.6 317.55 (SOUTHEAST RWY 27 ACTIVE 5500-8000)	
		127.35 363.125 (SOUTHEAST RWY 27 ACTIVE 5000 & BELOW)	
		127.35 363.125 (SOUTH 5000 & BELOW)	
		128.6 317.55 (SOUTHWEST 6500-10,000)	
		118.35 323.1 (SOUTHWEST 6000 & BELOW)	
		124.35 320.1 (WEST RWY 27 ACTIVE 10,000 & BELOW)	
		124.35 320.1 (WEST RWY 09 ACTIVE 8500-10,000)	
		128.4 273.575 (WEST RWY 09 ACTIVE 8000 & BELOW)	
		126.85 263.125 (NORTHWEST 7500 & BELOW)	
		124.35 320.1 (NORTHWEST 8000-10,000)	
WASHINGTON TRI-AREA CLASS B	BALTIMORE	119.0 282.275 (020°-100°)	CONTINUOUS
		124.55 317.425 (101°-130°)	
		119.7 290.475 (131°-180°)	
		128.7 307.9 (181°-019°)	
	DULLES	124.65 343.775 (091°-330°)	
		120.45 343.775 (241°-330°)	
		126.1 338.25 (331°-090°)	
	REAGAN	124.2 269.0 (EAST)	
	NATIONAL	119.85 322.3 (WEST)	
ATLANTIC CITY CLASS C		124.6 327.125 (130°-309°)	CONTINUOUS

VFR sectional chart tabular data

ATC and Airspace

Knowledge of which ATC facility controls the airspace you're in, and the location of the boundaries between these facilities, is important in planning and conducting an IFR flight. On IFR enroute low altitude charts, the controlling ARTCC facility and frequencies for contacting them via remoted sites are identified within small boxes with blue serrated borders. The boundary between contiguous ARTCC facilities' airspace is indicated by the same serrated blue line.

Airspace under the jurisdiction of approach control facilities in Class B and Class C airspace is denoted by a solid, light blue area on IFR charts and by magenta or blue lines on VFR charts. Approach control typically owns the airspace for 40 to 50 nautical miles from the airport at the center of the airspace.

Some approach control facilities are not graphically depicted on IFR enroute charts, but their

Approach frequencies for Class B and C airspace are easy to see on VFR terminal area charts as shown here. On sectional charts, Class C frequencies are shown the same way; however, you must refer to the tabulation printed on the side panel for Class B approach frequencies.

Air route surveillance radar (ARSR)

communication frequencies are found in the tabular data on VFR and IFR charts.

If you're on an IFR flight plan or have requested VFR flight following, you're already talking with controllers who can either provide weather updates or refer you to a frequency where you can get them.

Knowing who controls the airspace and where boundaries are can be helpful to VFR pilots, as well. For example: You're flying VFR at 4,500 feet. The forecast calls for a 40 percent probability of thunderstorms for later in the afternoon, and there's a buildup on the horizon. Has the convective activity started ahead of schedule? If you know whose airspace you're in and the frequency to use, you can call Center or Approach and ask about the presence of convective weather along your route. Knowing the airspace boundaries is important

Many pilots fly with GPS or loran receivers that feature extensive airport, ATC, and navigation facility databases. If you know where to look, it's a simple matter to find the appropriate communication frequency.

because radar coverage tends to be at its weakest along the border areas. If you need help from ATC to avoid the heavy weather, these areas of fringe coverage aren't the best place to get it.

ATC Radar

IFR flights in controlled airspace, or VFR flight under flight following, are nearly always tracked by ATC radar. This surveillance radar is designed primarily to see airplanes, and there are two basic types: airport surveillance radar (ASR) and air route surveillance radar (ARSR). ASR is used in approach control facilities in terminal areas; ARSR is used in ARTCC facilities. What's most important for pilots to know about them is what each can and can't see.

Precipitation as seen on Tracon radar

Surveillance Radar and Weather

The same radar that sees airplanes in the sky can also see some adverse weather. Unlike its 20-20 vision for spotting transponder-equipped aircraft, surveillance radar's vision for weather is, well, clouded. Furthermore, ASR and ARSR are not equal when it comes to seeing weather. Knowledge of how radar "sees" weather is the first step to understanding the basic weather information available from ATC. Radar transmits a radio wave that sweeps the sky as it revolves and listens for the return echo caused by the wave bouncing off an object. The returning energy is displayed on a screen as a primary return. Attached to the primary radar antenna is a secondary antenna that transmits a query to aircraft transponders. The transponder reply is called a secondary return.

Primary radar senses not only airplanes, but also terrain and weather. Radar energy is reflected by water in the form of rain. The more water, the stronger the return. The faster the radar turns, the greater the number of returns and the more comprehensive the picture of the echoes it "paints." However, as the speed of the sweeping radar increases, its range decreases. Hail and snow are poor reflectors of radar waves; thus, ATC radar is more limited in its ability to see them.

All radar is prone to certain errors. Radar waves can be bent and reflected by atmospheric phenomena besides rain. Temperature inversions, for example can create radar returns that look like precipitation. Controllers learn how to interpret most false returns, and they become familiar with errors that are common in particular areas due to surrounding topography or recurring atmospheric conditions.

Levels of Storm Intensity

For aviation, precipitation is measured in levels of intensity. Level one and level two may not make hearts flutter, but a level three activity ahead should command our undivided attention. The intensity levels are determined by the amount of water the radar detects, which is correlated to amounts of rainfall as follows:

Levels of Storm Intensity

Level	Intensity	Rainfall per Hour
1	Very light	Trace to .02"
2	Light to moderate	Up to .09"
3	Strong	Up to .48"
4	Very strong	Up to 2.5"
5	Intense	Up to 5.7"
6	Extreme	Up to 13"

Turbulence

How well does radar imagery of precipitation correlate with turbulence?

Doppler radar—the kind you see on television weather programs—can show air movement throughout and around thunderstorms. Provided this imagery is interpreted correctly, it can accurately show areas of turbulence.

Line of clouds seen from 68,000 feet

Unfortunately doppler radar isn't found in many cockpits, nor is it available to individual controllers so, for the present, we can only see precipitation.

High altitude studies conducted by NOAA and the U.S. Air Force[1] showed that significant turbulence does occur outside of the thunderstorm proper. How far the turbulence extends is hard to say, but pilots should avoid any convective activity by at least 20 miles. Even at that range, there's no guarantee you will avoid all the turbulence.

[1] *1973-1977 Rough Rider Turbulence-Radar Intensity Study.* J.T. Lee, D. Carpenter; National Severe Storms Laboratory, Environmental Research Laboratories, National Oceanic and Atmospheric Administration.

Turbulence Tips

• How clouds look can tell you a lot about the ride you'll get as you fly through them.

• Flat stratus clouds form in a stable atmosphere and will yield little or no turbulence.

• Cumulus clouds form in unstable conditions and will give you a rougher ride.

• Look at the shape of cumulus clouds. If the contours are rounded and pillow-like, the turbulence will most likely be manageable—hard angular contours indicate more turbulent conditions.

• Shredded clouds, torn apart by wind, usually predict turbulence.

• Lenticular clouds that form in mountain wave conditions have particularly well defined edges, and not surprisingly, they can be associated with extreme turbulence particularly below the cloud.

• Slow down well before entering the cloud or suspected turbulence area. This means maneuvering speed or less.

Slow down well before entering the cloud or suspected turbulence area.

• Remember that maneuvering speed (V_a) decreases as the aircraft weight decreases; i.e., a lightly loaded airplane with one pilot must be flown more slowly than one with all the seats filled.

• Don't chase the airspeed, but try to keep it within 10 knots of maneuvering speed.

• Lowering the landing gear can help to stabilize the aircraft, and the increased drag will help to keep you from overspeeding in the case of a momentary upset.

• Do not lower the flaps. The aircraft is strongest with flaps up.

• Fly attitude – not altitude.

• Concentrate on keeping the wings level. Turning imposes greater stress on the aircraft.

• The shortest way through the turbulence is usually a straight line.

• It's very difficult to maintain altitude in moderate or greater turbulence, so request a block altitude from ATC.

These clouds must be avoided.

• Don't make radical pitch changes.

• If you're using an autopilot, turn off altitude hold.

• Hail is another hazard that's often present in thunderstorms.

Terminal Radar

In airspace around major airports, ATC radar service is provided by Tracon—terminal radar control. The various forms of ASR found in these facilities are more accurate but have less range capability than the ARSR systems employed at center (ARTCC) facilities. Typically, ASRs have a range of 50 to 60 miles, but the practical limit is about 40 miles from the site.

Tracon radar display

The radar, together with software and hardware such as the controllers' display screens, comprise an automated radar terminal system (ARTS). The radar screen controllers look at, called the plan view display, or PVD, can show returns from both primary and secondary radar. Returns from the secondary radar—the transponder responses—are much stronger and easier to see, and the Mode C returns report aircraft altitude. That's why aircraft without Mode C transponders are excluded from within 30 miles of the primary airport in Class B airspace, the Mode-C veil.

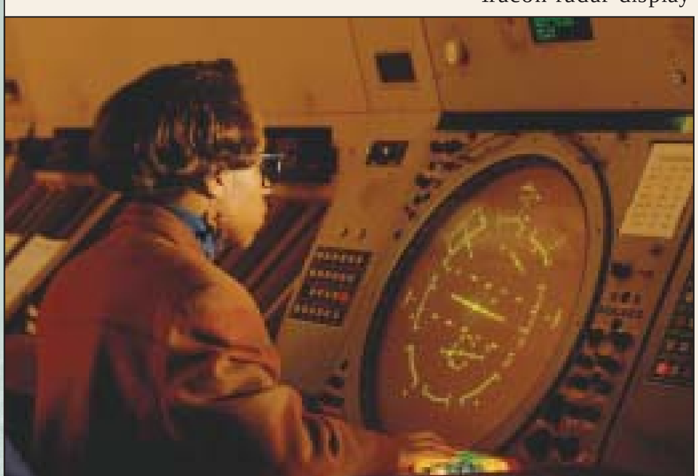
Terminal radars rotate every four to five seconds, compared to the 12-second sweep of ARSR systems. They are more accurate in showing

Aircraft data block

both aircraft and rain than ARSR systems, but their range is considerably shorter. This accuracy differential means that aircraft under terminal radar control radar need only three miles of separation, while those under center's radar require a five-mile separation. Accuracy decreases as range increases, so aircraft more than 40 miles from the terminal radar site must also be separated by five miles. At the limits of its range, surveillance radar can't distinguish between an aircraft and other objects in the atmosphere such as a large balloon, a flock of birds, or atmospheric phenomena such as a temperature inversion.

Older models of terminal radar (ASRs-4, -7 and -8), though still in operation, are being replaced or have been replaced at larger facilities by ASR-9 and ASR-11 systems. These newer systems have dedicated weather radar that works in conjunction with the surveillance radar. Computers process the weather radar data to create digitized composite weather images that are displayed on the controllers' PVDs.

Tracon radar display



With their dedicated weather radar antennas, ASR-9 and -11 systems display weather in six levels, corresponding to the six levels of precipitation intensity. To reduce visual clutter, the computer eliminates most indistinct returns from the screen. Controllers can select any two of the six levels for display on their PVDs.

Each aircraft under their control is tagged with a data block containing the aircraft's N number, a computer code number, altitude, and groundspeed based on history. When flying through an approach facility's airspace, pilots in radar contact will be directed to contact successive frequencies as they transit from one controller's sector to the next.

Radar in the tower

Additional Tracon Weather Monitors

Terminal facilities have additional weather monitoring devices besides the standard meteorological suite of barometer, anemometer, and thermometer.

• A low-level wind shear alert system (LLWAS), an anomaly detector, compares winds from sensors around the perimeter and center of an airport in order to spot indications of wind shear.

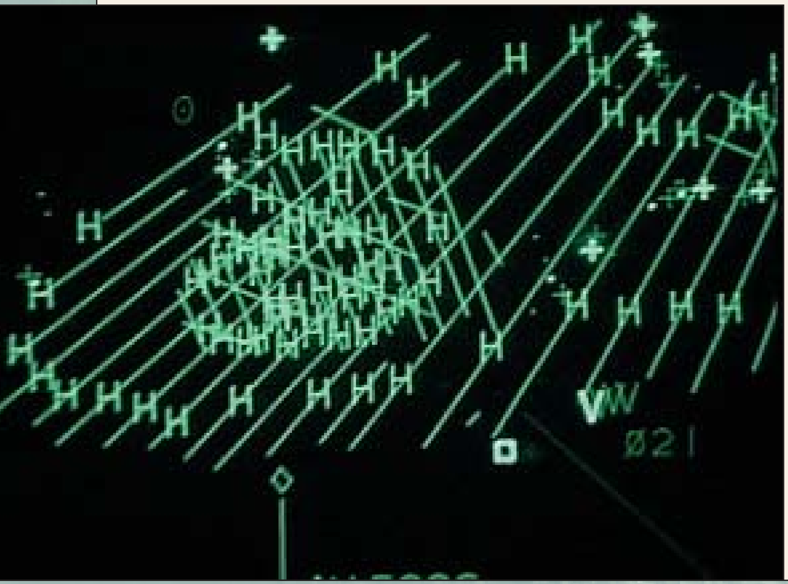
• Terminal Doppler weather radar (TDWR) will eventually replace LLWAS. TDWR looks at the

Terminal Doppler weather radar (TDWR)

airspace along approach and departure paths and over the airport to detect microbursts, gust fronts, wind shifts, and precipitation intensities. Pilots get better information with TDWR than LLWAS, but it's important to realize that this radar is designed to look only at the arrival and departure ends of runways—not all around the airport. TDWR will not detect gusty or crosswind conditions, but wind checks from the tower accomplish this. Neither will it detect turbulence, although that may be inferred when the wind is strong enough.

• Airport surface detection radar is used to watch traffic on taxiways and aprons. Though not typically thought of as weather radar, in times of low visibility due to fog or mist, it can help pilots safely navigate on the ground around large airports. Pilots unfamiliar with the field can ask for progressive taxi instructions, a wise request when the alternatives include possible incursion onto an active runway.

Hs indicate level 2 and higher rainfall rates.



Using Tracon Radar on the Ground

Pilots who launch into weather from airports served by Tracons have more resources to call on than those flying out of remote or nontowered airports with only a unicom and an ASOS for weather information.

Tower controllers often have access to the same weather information available to controllers in the Tracon. A monitor in the tower can display output from the facility's radar. While taxiing, pilots can request an update on area weather from ground control or from the tower just before takeoff. Before engine start-up or while waiting to taxi, pilots at Tracon airports can monitor approach control for wind shear reports or deviation requests.

Air Route Traffic Control Center—ARTCC

The hand-off from approach to center puts pilots in contact with controllers at one of the 21 ARTCC facilities across the country. Their air route surveillance radar (ARSR) -3 and -4 can pick up radar echoes from about 200 to 250 miles, respectively. The radar is usually located off-site from the ARTCC, on strategically high ground minimizing terrain obstructions. The primary radar consists of an array of several transmitters and receivers for expanded width of the coverage area. Here again, aircraft being tracked are tagged with data blocks, indicating the aircraft's N or flight number, assigned altitude, altitude climbing or descending through, destination, and groundspeed. The array's relatively slow rotating speed of five times a minute enhances its range. The PVD image, like those at approach control, is highly processed. Though the radar itself revolves, the traditional radar sweep is eliminated from centers' PVDs; the data blocks and position of targets on the screen move incrementally with each sweep of the radar.

Seeing Weather

On ARTCC PVDs, level 1, or light precipitation, shows up as long straight lines. "H"s indicate level 2 and higher rainfall rates. Cross-hatched areas showing a cluster of "H"s where the lines converge indicate heavy weather. (The cross-hatching is a composite picture from two or more radars simultaneously.) "H"s at the end of long single lines often indicate false returns. These returns are the controller's prime source of weather information to pass along to pilots. Center controllers do, however, have access to additional weather data.

The CWSU

Every ARTCC has a Center Weather Service Unit, or CWSU, staffed by a National Weather Service meteorologist. The meteorologist meets with the center's supervisor twice a day to review the weather and possible problems it may cause. The position of the jet stream and areas of rain, snow, icing, turbulence and thunderstorms are discussed. If the weather is expected to interfere with normal flight operations, controllers are informed.

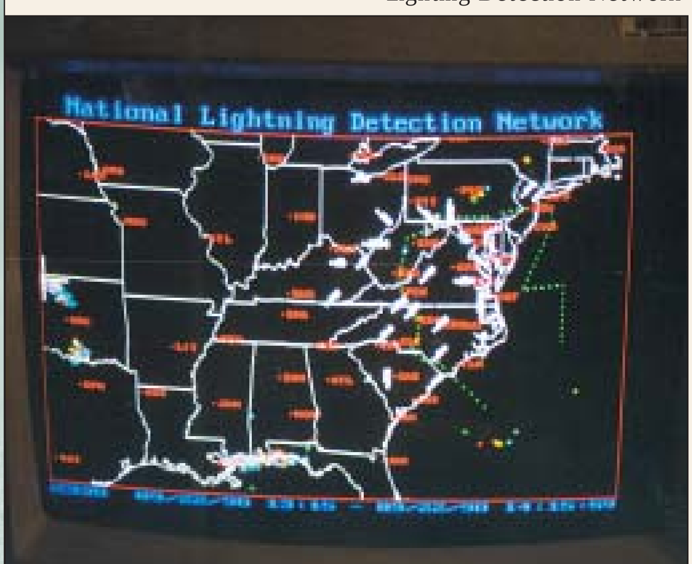
Cloud-to-Ground Lightning Monitor

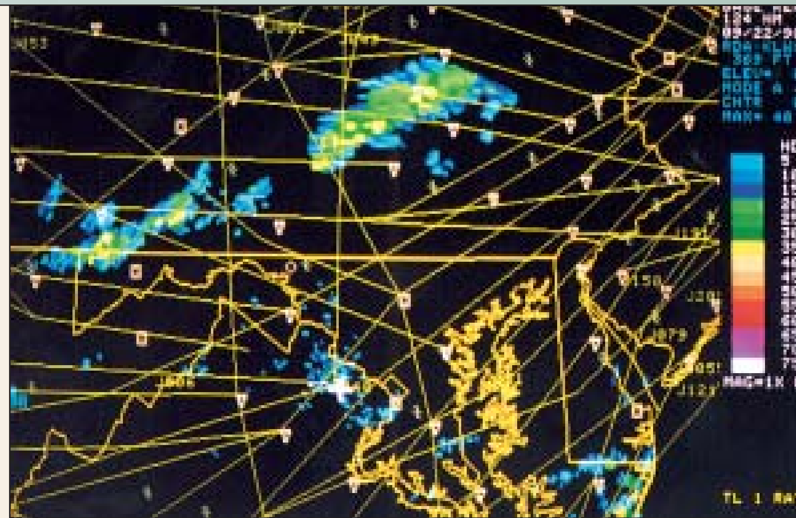
The cloud-to-ground lightning monitor is a graphic representation of thunderstorm activity across the United States. The color shows the activity's history. Cyan represents the first 55 seconds of lightning activity. After 55 seconds, the color goes to green, and to red after 5 minutes, enabling the screen to display where the storms are most violent.

The CWSU includes displays of weather sensors that may, in the not-too-distant future, be fed directly into cockpits in real time, vastly enhancing the safety of weather flying. For example, the national Doppler radar weather summary shows the echoes from Doppler radars all across the country, and the display (referred to as Nexrad) can be overlaid on airways to get a better glimpse of how and where the convective weather might affect flights. A nationwide network of cloud-to-ground lightning monitors likewise indicates thunderstorms and convective activity across the country in real time.

In addition to the briefing material, each supervisor's position has a dedicated weather

Lighting Detection Network





Nexrad overlaid on airways

briefing terminal that can display the same data available in the CWSU: radar maps, satellite data, text messages regarding significant weather—the works. Yet most of this information is rarely available to pilots via the controllers. Why? The controllers' primary responsibility is traffic separation, and in times when this information is most valuable—that is, in conditions of deteriorating weather—controller work loads are at their peak. Aircraft may request deviations, aircraft that might otherwise be flying VFR instead are IFR, and some traffic might require vectoring around the weather. This doesn't leave time for turning away from the PVD to consult the weather briefing terminal. In addition to work load constraints, controllers are not trained as meteorologists, and some are, naturally, reluctant to take on that role.

What Are Your Intentions?

Despite not being trained as meteorologists, controllers may advise pilots if they are on a collision course with hazardous weather. Controllers can make suggestions for storm avoidance, but they can't tell pilots what to do. They may simply advise of convective activity ahead, or less often, they may suggest a heading for a deviation. Why don't they tell pilots what to do about avoiding weather? First, they don't know the limitations or abilities of a given pilot or his aircraft. One pilot may have no problem coping with level 2 precipitation, whereas another will want to stay well clear. As we've already shown, radar—particularly center radar—does not show all the weather. Finally, there is a liability issue. If an accident occurs following the issuance and acceptance of such instructions, the FAA could find itself in court.

Once in the air, deal with what is actually happening—not what was supposed to happen.

Often getting the information you need is simply a matter of asking the right questions:

• Are you showing any weather along my route?

• Is it showing as light or heavy?

• Has anyone flown through that area recently, at or near my altitude?

• How was their ride?

• If pilots are avoiding that area, in which direction are they deviating?

• Can you give me a heading to follow the successful deviators?

The same line of questioning can be used regarding icing or turbulence, although these do not show on radar. The controller will be relying on pilot reports. ATC will supply you with weather information and suggestions to the extent possible, but the resulting decisions, and the consequences, are all yours.

Sometimes it may take a few moments to digest the information and decide what to do about it. Of course, controllers want to know your course of action immediately; they have to separate you from airplanes. If you don't have a quick answer, the controller may ask, "What are your intentions?" If you're not sure, you can ask for more help; for example, request vectors for getting around a cell. You need to be aware of the options available to you. It could be a change of altitude to get over or under the weather or a deviation to the right or left. It's up to you as pilot in command to know the tactics at your disposal and make the right decision.

Deviations

ATC will let aircraft deviate as long as they don't constitute a collision hazard. Deviation is as much art as it is science. Here are a few tactics:

• Try to deviate north of convective activity; usually the south side contains the water that's fueling the storms.

• Give a wide berth to the downwind side—the direction the storm is moving—as turbulence may extend far into clear air. Because storms often move from southwest to northeast, this suggestion might seem to conflict with the one above. Tornadoes most often form on the southwest side of storms, though, so you're usually better off with northerly deviations.

• Don't fly under anvils and overhangs. That's where your chance of hail encounters is greatest.

• Come no closer than 20 miles to the weather you're deviating around.

Time Out

Let's take a moment to put things in perspective. This publication deals with tactics for flying in or around weather, but pilots must realize that there are some weather situations that no airplane/pilot combination is capable of handling. In other words, all the technology in the world will not make unflyable weather flyable.

The pilot in command is responsible for knowing when to press on and when to call it a day. We must regularly evaluate the weather and our airplane's capability and our own as each flight progresses. If the weather is more than we can handle, we're responsible for the decision to divert, land, and wait for conditions to improve, or turn back and try it another day. The pressure of this decision is greater when we have a schedule to keep or passengers to impress, but the decision must be made **solely on the safety of flight**. Unless your passengers are also qualified crew members, it's best to make the decision without their input.

• If a deviation is required, ask for it as soon as possible. This will give the controllers time to coordinate with other traffic.

• Try to deviate 45 degrees or less from course. Controllers don't like to process requests for 90-degree deviations because they greatly complicate the separation task and the need for coordination with other control sectors is likely.

• If you want to climb over some clouds but don't want to request and remain at a designated altitude, ask for a block altitude. This request will more likely be granted when traffic density is light.

• When requesting a deviation, keep the routing as simple as possible. Remember, if the weather is affecting you, it's probably affecting lots of other pilots too, and the simpler you can keep the request, the more likely you are to get what you ask for.

• If your request is met with an "unable" at a critical juncture and you're worried about flying into dangerous weather, you can invoke your rights as pilot in command to deviate in accordance with FARs 91.3 and 91.123. However, if you're paying attention and working with ATC properly, it shouldn't come to this.

Controllers can make suggestions for storm avoidance, but they can't tell pilots what to do.

Additional Enroute Weather Sources

Getting enroute updates can reduce the stress of cross-country flying in challenging weather. Pilots on VFR cross-country flights should also use these resources, due to the ever-present possibility of deteriorating conditions that lurks in even the most optimistic forecast.

Often getting the information you need is simply a matter of asking the right questions.

Flight Service Stations (FSSs)

Flight service stations remain a mainstay of aviation weather resources. Enroute, their primary contact frequency is 122.2. The same information is available in telephone briefings, and pilots are encouraged to use the phone whenever possible to avoid frequency congestion. FSS communicates with pilots through remote transmitters, so replies are only heard by radios in the appropriate area. Thus, it's important to state the aircraft's position when contacting flight service. The name of the controlling facility is helpful, too, but as long as you tell them your position and frequency—"Leesburg Radio, this is Debonair One-Five-Eight-Eight Sierra, fifteen south of the Philipsburg VOR, 122.2"—if they hear you, they will respond.

Flight Watch

Flight Watch, also known as the Enroute Flight Advisory Service, or EFAS, is designed to provide information on weather affecting your route of flight, as the name implies. It's available on frequency 122.0 from 6 a.m. to 10 p.m. daily, at altitudes from 5,000 to 17,500 feet and on selected frequencies for high-altitude flights. Provided through selected FSSs, it's not meant to provide detailed briefings like FSS or for filing flight plans. When you need quick, concise information about actual or suspected adverse enroute conditions, this is the frequency to use.

Call an enroute tower to ask about current weather conditions.

Again, it's imperative to state your position in your initial report, so that briefers know which remote transmitter to use.

Flight Watch briefers are specially trained to provide the real-time weather information pilots need to make in-flight decisions. They have the latest Nexrad Doppler radar image composites on a monitor at the briefing console. They also have pireps and surface observations. Flight Watch blurs the line between strategic and tactical planning. In one sense, if you're in the air, all your decisions are tactical, but pilots have to keep in mind the age of the information they've received. Pireps can age quickly in fast-developing weather situations, and even Nexrad images may be up to 15 minutes old. Add to that the difficulty of relating your position to the weather described by the briefer, and you can see that the earlier you talk to Flight Watch, the more time you'll have to deviate well clear of the hazards.

The same questioning routine you use with ATC controllers will work with Flight Watch.

- Where is the weather?
- What are the pilots saying about it?
- What's the best way to turn?
- Where are the successful deviators going?

You can also learn a lot about developing weather by simply listening to Flight Watch. When things are popping, you can usually hear a lot of weather information requests on 122.0. Monitoring the frequency for a few minutes before contacting the briefer can save time when it's your turn to ask the questions.

Automatic Terminal Information Service (ATIS)

These hourly updates on airport weather, broadcast at many towered airports, are a valuable enroute tool. Monitor ATIS reports from nearby airports. Though the weather may be up to an hour old, any significant changes will be marked by a special observation, an easy giveaway about trends. You don't even have to leave the frequency to do it (assuming you have two radios—always a good idea when flying IFR). Just monitor the ATIS frequency on your second radio.

Tower

This is another ATC facility few pilots contact unless departing, landing, or when requesting a transition through Class D airspace. What's going on under a cloud deck? Center may not be able to see on their radar, but the controller in the tower at a nearby airport can tell you. You can request a frequency change to check in with an enroute tower.

ASOS—Automated Surface Observation System

ASOS is a valuable tool, bringing weather information to hundreds of airports where none existed before. It is also envisioned as a replacement for observers at many airports now staffed by human weather watchers. Due to limitations in equipment or in siting, ASOS can give false reports on ceilings and visibilities, and it's most prone to error in rapidly changing weather conditions. Therefore, a single ASOS report cannot be relied on as accurate during changing conditions. ASOS stations should be monitored for at least a 10-minute period if possible, with attention paid to trends.

Pilot Reports

Controllers get pilot reports all the time, but they're not always passed along. Ask if the controller has any pireps relevant to your route of flight. You can also solicit pilot reports through a controller. For example, ask if there are any reports of turbulence, icing, or precipitation up ahead. Controllers will often query other pilots on the frequency who are flying through the area you're asking about. "Beech 88 Sierra, how's the ride?" they may ask, or "Beech 88 Sierra, what are your current flight conditions?" That's some of the best weather reporting you can get. It's just as important to give pireps as it is to receive them. Other pilots are vitally interested in your experience, and they'll appreciate information on good weather as well as bad. Are conditions better, the same, or worse than forecast? Make it a habit to forward several pireps each flight. Any contact with Flight Watch should include a pirep.

New Private or Instrument Certificate?

While we have given you some guidance in the tactics of weather flying, there is no substitute for actual experience. The AOPA Air Safety Foundation encourages all new pilots, both VFR and instrument, to team up with a seasoned instructor or mentor. The private pilot certificate or instrument rating is only the beginning of learning tactical weather flying. Most pilots get very limited experience during basic training, and the weather is frequently too good. Take the time to explore carefully—your skill and confidence will improve tremendously.

Approaches in Adverse Weather

Every safe pilot knows the dangers of "get-home-itis" or "get-there-itis." We must be especially careful to maintain our objectivity when deciding whether to continue to a destination airport or continue an approach when hazardous weather is in the vicinity If

ASOS brings weather information to hundreds of airports where none existed before.

convective activity is in the area, look for tipoffs regarding its severity. In the summer, dew points above 50 degrees, for example, may indicate the presence of the enough moisture to set off a thunderstorm. And a temperature/dew point spread of 35 to 40 degrees or more is a sign that if a rainshower starts, it will rapidly build in intensity. A rule of thumb some seasoned pilots recommend is never conducting an approach when thunderstorms are within five miles of the approach corridor. Pilots should also be aware that severe-storm gust fronts can reach much farther than five miles. Approach controllers can tell you if airplanes ahead of you are completing the approach or waiting for the weather to pass. Tower controllers can provide especially useful information when you're close to the field. They can give you real-time information on weather at the airport. If you have two radios, you can monitor tower during the initial stages of the approach.

Ultimately, radar cannot be relied on completely. Convective activity can boil up in a matter of minutes. You may descend into a deck of clouds on approach with no weather visible on radar and find yourself in heavy precipitation on final. That's why it's important to remember the limitations, as well as the abilities of ATC services. Practice using them in times of good weather, and you'll make much better use of them in the bad. Combine ATC's resources with your own tactical abilities, and your flying will be not only safer, but more enjoyable as well.

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